NOTES FOR STUDENTS

Inheritance of sex.—CORRENS[3] has continued his studies on gynodioecious plants in order to discover what determines the sex of the flowers on the gynomonoecious individuals, and the sex of the two classes of individuals belonging to such species. He finds that the curve of frequency of hermaphrodite flowers in *Satureia hortensis*, instead of presenting two modes, as previously reported by him, one in the mid-season and one at the end of the season, has only a mid-season mode. The mode which appeared at the end of the season was due to the repeated counting of flowers which remained open more than one day.

During the middle of the season no flowers open on the second day, but late in the season the petals seem to be more resistant, and climatic conditions are less severe, so that the same flowers were unwittingly counted several times. When each flower is marked as it is counted, it is found that the proportion of hermaphrodite flowers continues to fall till the end of the season.

He also tested the effect of environmental conditions upon the percentage of hermaphrodite and female flowers produced on plants of Satureia from day to day, and noted the position occupied by each kind of flower on the plant. The results show that poor nutrition, whether the result of poor soil, insufficient illumination, or disadvantageous position on the plant, lessens the proportion of hermaphrodite flowers, and under the combined influence of both poor soil and poor light, only 13 per cent. of hermaphrodite flowers were produced as compared with 79 per cent. produced under normal conditions of culture. However, the general features of the curve of frequency of the hermaphrodite flowers remain the same. With high nourishment the curve for the hermaphrodite flowers falls much more gradually toward the end of the season, though during the early part of the season it is not essentially modified.

It was found that different strains of Satureia show marked differences in the actual percentage of hermaphrodite and female flowers, but that in each case the general features of the curve of frequency are the same. The conclusion is reached that whether hermaphrodite or female flowers are to be produced by a gynodioecious individual is dependent upon nourishment in its widest sense. The same general results may be demonstrated in Geranium, *Silene inflata* and *S. dichotoma*, *Plantago lanceolata*, Scabiosa, Knautia, and Echium.

DARWIN had observed that a single hermaphrodite plant of *Satureia hortensis* was "rather larger" than the female plants of the same species, and in an earlier paper CORRENS had apparently substantiated this observation, without realizing the possibility that some of the plants classed as female might be hermaphrodite plants, rendered *apparently* female by poor nutrition. He undertook to determine the relative weights of these two classes of plants with a more careful analysis of the material. The results show that there is no difference in weight between the

3 CORRENS, C., Weitere Untersuchungen über die Geschlechtsformen polygamer Blütenpflanzen und ihre Beeinflussbarkeit. Jahrb. Wiss. Bot. **45**:661–700. *figs. 11.* 1908.

female and gynomonoecious plants, and therefore the difference in weight which was assumed by DARWIN to be a secondary sexual character has no such significance.

CORRENS has also investigated[4] the percentage of female and hermaphrodite plants in *Plantago lanceolata* under conditions of controlled pollination, and has shown that while this plant, like Satureia and Silene, shows a marked tendency for each sex to reproduce its own kind, nevertheless there is considerable variation in this regard in individuals of both sexes. By pollinating the same female individual with different hermaphrodite individuals, and by pollinating different females with pollen from the same hermaphrodites, it was shown that the proportion of hermaphrodite offspring and of females is so related in each case that they may be readily calculated, after once the strength of the hermaphrodite tendency in the pollen-parent and of the female tendency in the pistil-parent is known. In other words, each individual appears to have a different strength of these two sex-tendencies and to produce germ-cells of two kinds with respect to these tendencies, the number of each kind of germ-cells produced being perhaps roughly proportional to the strength of the sex-tendencies in the parents.

The theory that the germ-cells of *Plantago lanceolata* do not themselves vary in their tendency to produce a certain sex, but that they are definitely either female or hermaphrodite, puts these plants into the class known as ever-sporting varieties, and makes this paper also a valuable contribution to the study of this recognizedly difficult type of inheritance.

The assumption that each germ-cell is definitely female or hermaphrodite and that the female is dominant allowed the prediction of the actual numbers of each sex produced in the different experiments with a fair degree of accuracy.

Several other papers have recently appeared dealing with the question of sex-determination. DONCASTER and RAYNOR[5] found that in crosses between *Abraxas grossulariata*, a common English moth, and its rare variety *lacticolor*, reciprocal crosses are not equal, for when a *lacticolor* female is crossed with a *grossulariata* male, no *lacticolor* offspring are produced, and males and females are all *grossulariata;* but when the reciprocal cross is made, all of the females are *lacticolor* and all of the males *grossulariata.* To explain this strange situation the authors assumed that sex is a Mendelian character, and that the *lacticolor* character is coupled with the female determinant. It was assumed that both male and female individuals are heterozygous with respect to sex. In this regard their interpretation differed fundamentally from that of CORRENS, who assumed that in the case of *Bryonia alba* × *dioica* and other dioecious plants the female sex is homozygous, and the male heterozygous.

BATESON and PUNNETT,[6] in discussing DONCASTER's results, show that a

[4] CORRENS, C., Die Rolle der männlichen Keimzellen bei der Geschlechtsbestimmung der gynodioecischen Pflanzen. Ber. Deutsch. Bot. Gesells. **26a**:686–701. 1908.

[5] Proc. Zoöl. Soc. **1**:125. *pl. 1.* 1906.

[6] Science N. S. **27**:785. 1908.

simpler explanation may be given by assuming that the male is homozygous and the female heterozygous with respect to sex, and that there is a repulsion between the determinant for the *grossulariata* character and that for the female sex. These assumptions fit all of the facts brought to light in the crosses of Abraxas. This point of view has been briefly restated by DONCASTER[7] in a report to the Evolution Committee of the Royal Society, where a summary of the matings and their results is given. Another case has been reported which seems to correspond very closely with that of Abraxas. The "cinnamon" canaries, i. e., those having plumage of a brownish tint, have pink eyes when hatched. The green canary has black eyes. Misses DURHAM and MARRAYAT[8] have found that when a pink-eyed hen-canary is crossed with a black-eyed cock, all the young of both sexes are black-eyed. The reciprocal cross shows all the male offspring black-eyed, while all the pink-eyed offspring are females, though a few black-eyed hens may occur. The latter are as yet unexplained, but there seems to be little doubt that this cinnamon canary will find an explanation essentially like that given for Abraxas.

Great advances have likewise been made in the study of the determination of sex from the cytological side, mainly through the work of MCCLUNG, STEVENS, MORGAN, WILSON, and their students. In nearly one-hundred species of insects belonging chiefly to the Hemiptera and Coleoptera, it has been found that there are definite chromosomal differences between the male and female, and that the odd chromosomes, or "accessory" chromosomes as they were called by MCCLUNG, are so distributed at the time of the reduction division that all the female germ-cells are alike, while the male germ-cells are of two kinds. The chromosome group of one of these two types of male germ-cells is like that of the egg-cell, and when such a sperm fertilizes an egg, a female zygote is produced. The other type of sperm has a chromosome group unlike that of the egg, and fertilization with such a sperm produces a male zygote.

An excellent résumé of this work and a discussion of the entire problem of sex-heredity is given by WILSON,[9] who has been most prominently engaged in these new discoveries. Showing how experimental breeding and cytology supplement each other, WILSON lays emphasis upon the necessity of bringing different methods of scientific investigation to bear upon difficult scientific problems like this, and the undesirability of depending upon any single method. In this day of intense specialization this is more fundamental than ever before. Similar cooperation would even improve general discussions of a subject which is being developed simultaneously by different methods, for it has become difficult for anyone to give an ade-

---

7 DONCASTER, L., On sex-inheritance in the moth, *Abraxas grossulariata* and its var. *lacticolor*. Reports to the Evolution Committee 4:53–57. 1908.

8 DURHAM, F. M., AND MARRYAT, D. C. E., Note on the inheritance of sex in canaries. Reports to the Evolution Committee 4:57–60. 1908.

9 WILSON, E. B., Recent researches on the determination and heredity of sex. Science N. S. 29:53–70. 1909.

quate treatment of such a subject. WILSON'S discussion would have been rendered simpler and more cogent, if he had grasped the logical homologies between plants and animals now generally accepted by students of genetics. He does not seem to appreciate the fact that it is the *gametophyte* of plants which finds no clear homologue in animals, and so fails to assign a proper degree of importance to the parallelism between the sporophyte and the animal body or soma. Again, if he had been more familiar with the most recent developments of Mendelian theory he would have found that the discoveries in these insects are in perfect accord with Mendelian heredity. Instead of this, he presents as a "naïve assumption" what is now generally held by the students of Mendelism, and known as the "presence and absence hypothesis," the assumption being that the heterozygote and the positive homozygote differ from each other in that the former has an unpaired unit, X, and the latter a pair of units of the same kind, XX.

CASTLE[10] takes up this question and shows the perfect agreement between the results of these cytologists, and the requirements of the presence and absence hypothesis in Mendelian heredity. In CASTLE'S exceedingly clever discussion an attempt is made to harmonize the apparently antagonistic results with Bryonia, the Hemiptera, and Coleoptera on the one hand, and those with Abraxas and the cinnamon canaries on the other, by assuming that in all cases the female possesses one more unit than the male, this unit being called by WILSON the "X-element." Bryonia, and all of the insects whose male germ-cells have been found to be of two kinds, represent a condition in which the male is a heterozygote, and the female is a *positive homozygote*. CASTLE calls this a "dominant female," but this is obviously a misleading terminology, for if the female were *really dominant* the heterozygote would also be a female and there could be no males. In Abraxas, and the cinnamon canaries, and, as suggested by CASTLE, perhaps also in the pheasant, the female is heterozygous and the male is assumed to be a *negative homozygote*, i. e., wholly lacking the X-element. This is the most promising attempt yet made to bring all the recently discovered facts of sex-heredity in dioecious animals and plants under a single hypothesis.

CASTLE attempts further, by an extension of the same hypothesis, to account for the fact that male animals usually possess more characters than the female. He supposes that these added male characteristics are associated with or produced by a Y-element, the "synaptic mate" of the X-element. He also suggests that progressive evolution may have taken place by the appearance and development of such a "synaptic mate" for the X-element, but this, and also the attempt to explain orthogensis on the same basis, is carrying hypothesis rather far from empirical knowledge.

There can be no question that the problems of sex possess many intricacies and difficulties yet to be solved, but the results of these investigations both from the experimental and the cytological side have placed these problems on a new

---

[10] CASTLE, W. E., A Mendelian view of sex-heredity. Science N. S. **29**:395–400. 1909.

basis, and opened up many possibilities and suggestions for their further investigation. All of the results seem to point to the truth of the view that sex is predetermined in the germ-cells, and that therefore it cannot be modified by environmental conditions except, of course, by such conditions, as yet unknown, as are capable of producing mutations.—GEORGE H. SHULL.

Current taxonomic literature.—N. L. BRITTON and J. N. ROSE (Jour. N. Y. Bot. Gard. **9**: 185–188. 1908) have proposed a new genus (*Carnegiea*) of the Cactaceae. The genus is based on the well-known *Cereus giganteus* Engelm., and contains but the one species. H. PITTIER (Contr. U. S. Nat. Herb. **12**: 171–181. 1909) has published 8 new species of flowering plants from tropical America. The descriptions are supplemented by two full-page illustrations and several text-figures; the types are deposited in the U. S. National Herbarium. A. THELLUNG (Bull. Herb. Boiss. II. **8**: 913, 914. 1909) records 3 new varieties of *Lepidium pubescens* Desv. from South America. F. STEPHANI (*ibid.* 941–972) has published 43 new species of the genus Mastigobryum from various localities. G. BEAUVERD (*ibid.* 986–988) has published a new Eriocaulon from Brazil and also a new species of Tulbaghia from the Transvaal; the same author (*ibid.* 993–1007) records 8 new species and one variety of Nothoscordum from Uruguay and gives an analytical key to the Uruguayan species. E. G. PARIS (Bull. Soc. Bot. France IV. **8**: Mém. 14, pp. 1–66. 1908), under the title *Florule bryologique de la Guinée française*, has published 6 new species of mosses. F. GAGNEPAIN (*ibid.* Session extr., pp. xxxvi–xliii) has published 4 new species of Zingiberaceae and a new genus (*Ataenidia*) of the Marantaceae from Africa, and also a new species of Calathea native of Indo-China. G. BONATI (*ibid.* 509–515, 537–543) describes 25 new species and 4 new varieties of scrophulariaceous plants from Indo-China. F. GAGNEPAIN (*ibid.* 521–527, 544–548) has published 12 new species of Asiatic plants belonging to the Bixaceae and Pittosporaceae. F. KRÄNZLEIN (Fedde Rep. Nov. Sp. **6**: 18–23. 1908) publishes 8 new species of Orchidaceae from Bolivia. WOLFF (*ibid.* 24) records a new Eryngium from Bolivia. O. BECCARI (*ibid.* 94–96) records 4 new species of palms from the Antillean region. W. WANGERIN (*ibid.* 97–102) has published 13 new species of the genus Cornus, chiefly from China. E. HACKEL (*ibid.* 153–161), under the title *Gramineae novae V*, has published 8 new species and 5 varieties of grasses from Bolivia. E. L. GREENE (*ibid.* 161) records a new species of Argemone from New Mexico. E. ROSENSTOCK (*ibid.* 175), in an article entitled *Filices novae IV*, has published 4 species and one variety of ferns as new to science. B. P. G. HOCHREUTINER (Ann. Conserv. et Gard. Genève **11–12**: 136–143, reprint pp. 1–8. *pls. 1, 2.* 1908) has published a revision of the genus Adansonia in which 8 species are recognized, one of which, *A. Stanburyana* from northwestern Australia, is proposed as new to science. G. A. NADSON (Bull. Jard. Imp. Bot. St. Petersb. **8**: 113–121. *pl. 1.* 1908) describes a new microorganism (*Rhodosphaerium diffluens*) from the Caspian Sea; the systematic position of the plant according to the author is "an der Grenze zwischen Algen und Bakterien." C. FERDINANDSEN and O. WINGE (Bot. Tids-